Space Weather Technical Forecast

Issued on Saturday, 30 July 2022 at 13:04 Local

This technical forecast provides a four day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

Space Weather Forecast Headline: Chance of G1/Minor Storm intervals days 1 and 2 (30th and 31st).

Analysis of Space Weather Activity over past 24 hours

Solar Activity: Solar activity has been Very Low over the past 24 hours, with no significant flares. There are currently three sunspots on the visible disc, with a new and currently unnumbered sunspot emerging in the southwest quadrant. AR3038 Dsi/Beta is the largest region, with some intermediate spot growth in the last 24 hours. The other two regions are small and simple.

A filament eruption seen to be lifting off in the far southeast quadrant has produced a Coronal Mass Ejection (CME), although the bulk of the CME appears to be heading southwards, as seen in STEREO-A imagery. Further analysis is currently taking place to ascertain any potential Earth-directed component, but this is considered to be unlikely.

Otherwise, no Earth-directed CMEs were observed.

Solar Wind / Geomagnetic Activity: Solar winds, as measured by DSCOVR at L1, were predominantly at background levels, between 320-380 km/s. Density was initially average, with a steady rise to above average from 30/0640UTC, peaking at 18ppcc at time of writing. The total interplanetary magnetic field (IMF), Bt, was mostly weak to moderate, peaking around 8 nT, with the north-south component, Bz, fluctuating between +6nT to -4nT. The Phi angle was mostly negative (towards the Sun). Geomagnetic activity was Quiet (Kp 0-1).

Energetic Particles / Solar Radiation: The high energy proton flux (10 MeV), as measured by GOES-16 was at Background levels. The High energy electron flux (greater than 2MeV) varied between Background and Moderate levels, with a brief peak of 759pfu observed at 29/1640 UTC. Electron fluence showed a declining trend, remaining well below the Active threshold (1e8 integrated flux), with an observed fluence of 2.06e7 integrated pfu recorded at 30/0000 UTC.

Four-Day Space Weather Forecast Summary

Solar Activity: Low to Very Low solar activity is expected to continue, with only a slight chance of M-class flares.

Solar Wind / Geomagnetic Activity: No CMEs have been assessed as Earth-directed. Background winds initially, before the arrival of the fast wind of CH04 day 1 (30th), perhaps into day 2 (31st). Solar winds likely gradually easing day 3 and 4 (1st and 2nd), but could see further enhancement from the southern coronal holes (CH06/CH07) by the end of the period.

Geomagnetic activity is forecast to be mainly Quiet with a chance of Unsettled intervals, then Unsettled with Active intervals with a chance of G1/Minor storm with the arrival of the fast winds day 1, perhaps into day 2 (30th and 31st). Activity easing back to Quiet to Unsettled thereafter,

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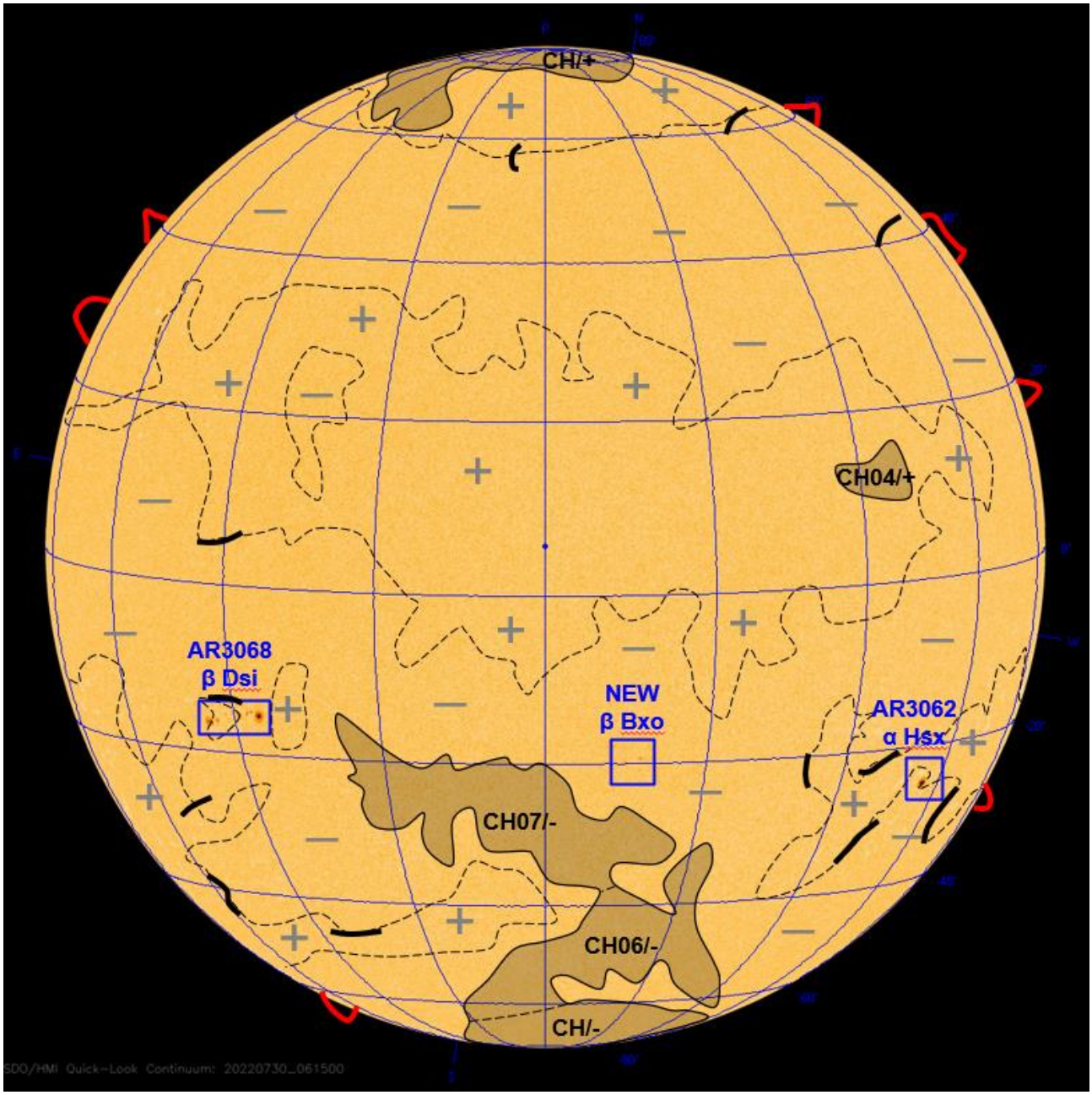
but with a slight chance of increasing to Active to G1/Minor Storm by the end of the period.

Energetic Particles / Solar Radiation: The high energy proton flux (greater than 10 MeV) is expected to remain at Background levels. The high energy electron flux (greater than 2 MeV) is expected to remain mostly at Background and Moderate levels, but with a chance of rising to give diurnal peaks of high as the fast wind of CH04 recedes day 3 onward (1st). The corresponding 24 hour fluence is forecast to remain below the Active threshold (1e8 integrated pfu).

Figure 1. Solar Analysis Valid 30/0615UTC.



Key: Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

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Geomagnetic Storms:

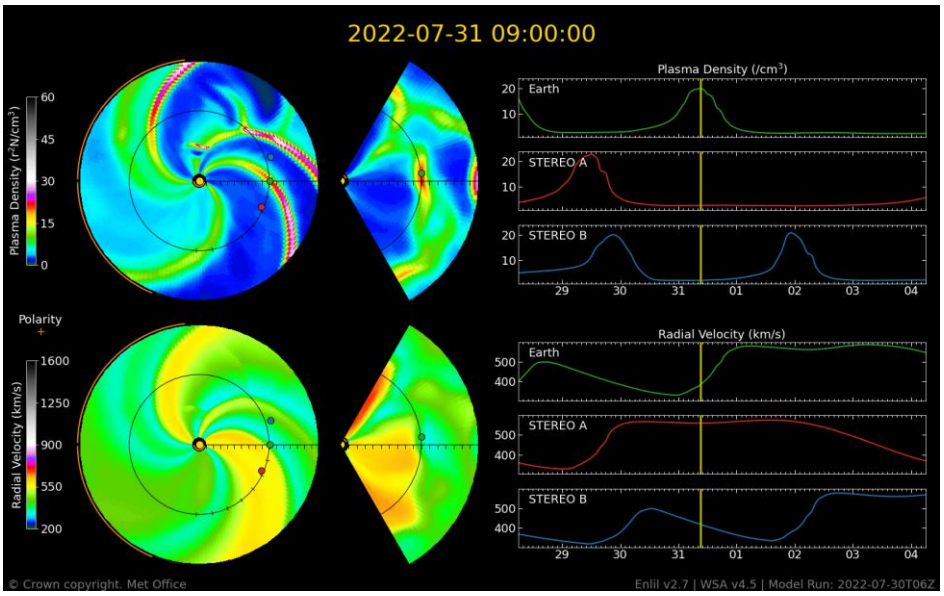
No CMEs have been assessed as Earth-directed for this period.

Solar winds have persisted at background, ahead of CH04/+ whose fast wind is expected to arrive later day 1 or potentially early day 2 (30th or early 31st). The initial arrival would correspond to a weak enhancement observed at STEREO A around 28/1400 UTC, as this spacecraft observes solar wind conditions around 1.9 days ahead of Earth. There is some uncertainty however, as a further enhancement has been observed around 29/1800 UTC.
This uncertainty is compounded by the lack of useful persistence data, and Enlil appearing to have an erroneous strong and broad enhancement early on the 31st whose source is uncertain. Some enhancement is possible later in the period from CH06/CH07, which are northward extensions of the southern polar crown. However with Earth north of the solar equatorial plane, any such enhancement is very low confidence.

Overall initially Quiet geomagnetic activity is likely to become Unsettled with Active intervals and a chance of G1/Minor Storms with the arrival of any fast wind of CH04. These conditions will ease to Quiet to Unsettled day 3 onward, but with a slight chance of Active to G1/Minor Storm intervals returning with any further enhancement.

Geo-Magnetic Storm	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability (Exceedance)			(%)	(%)	(%)	(%)
Minor or Moderate	G1 to G2	No	30	20	5	10
Strong	G3	No	1	1	1	1
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

Figure 2: Enhancement showing on day 2 (31st) onwards in Enlil.



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Radio Blackouts - X-Ray Flares:
Solar activity is currently Very Low, with no significant flares. There are currently three sunspot groups on the Earth-facing disc, one of which is currently unnumbered in the southwest. The largest and most active is AR3068 Dsi/Beta in the southeast. While still relatively small, this had seen development of intermediate spots, although this region appears to have now stalled in growth. The other two regions are both small and stable.

Far-sided products do suggest the potential for further regions to rotate onto the Earth-facing disc through the period, with the next anticipated region being ex-AR3053, likely emerging from over the northeast limb on day 3 (1st).

Activity is expected to remain Low to Very Low, with only a slight chance of rising to Moderate from any M-flares, most likely from AR3068.

X Ray Flares Probability	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	R1-R2 M Class	No	10	10	10	10
Very Active	R3 to R5 X Class	No	1	1	1	1

Figure 3: GOES 16-17 X-Ray Flux

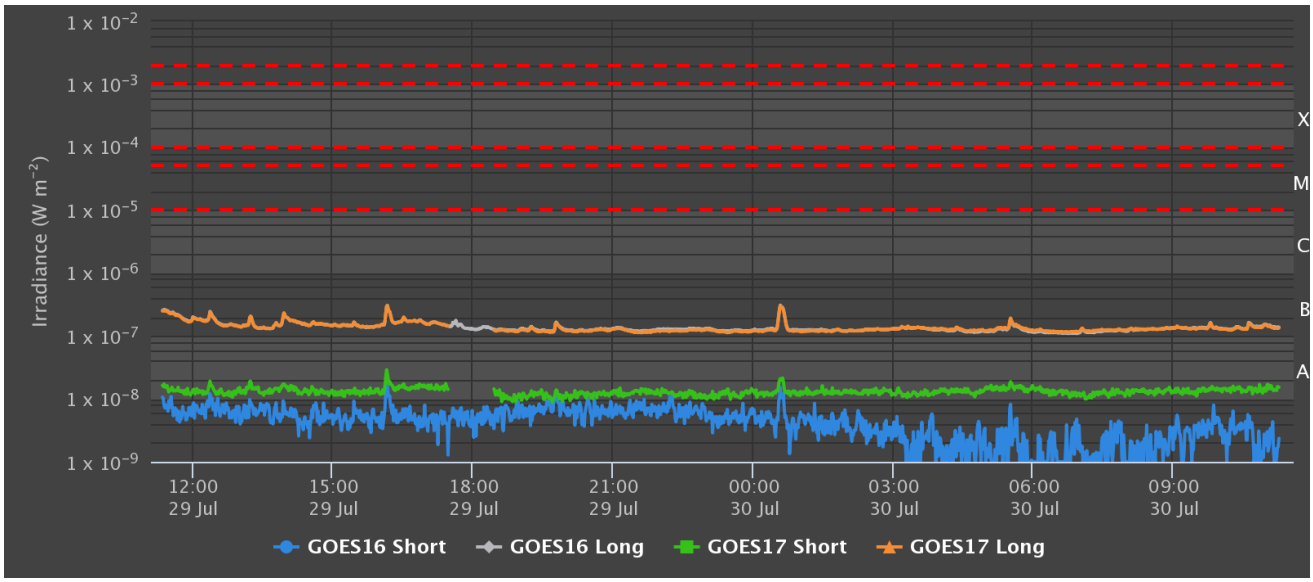

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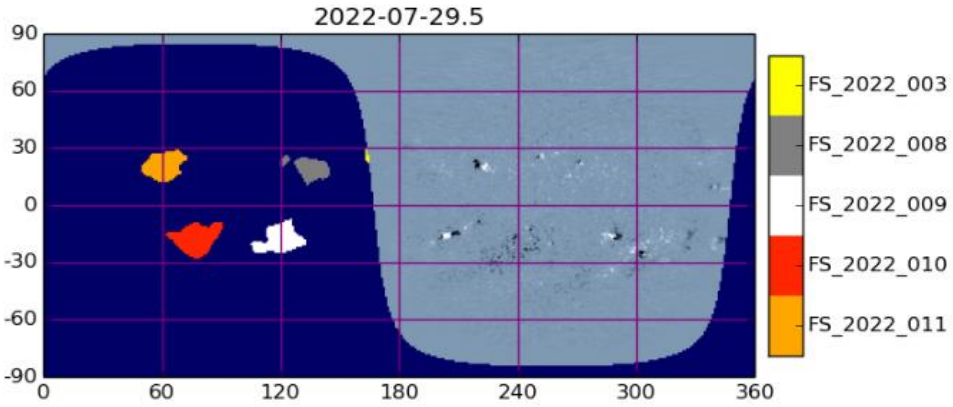
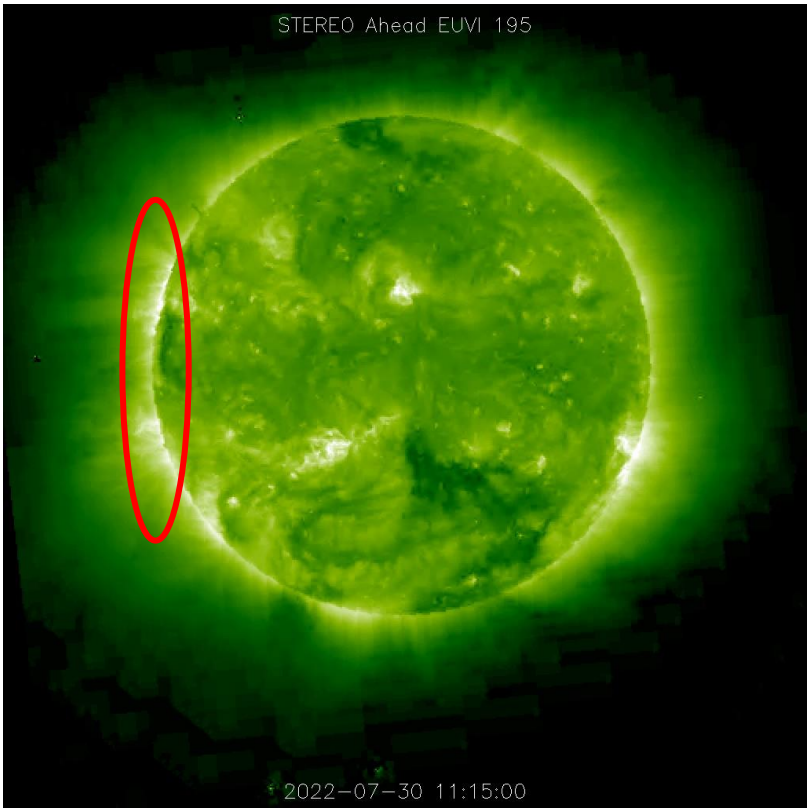
Figure 4: Stanford Helioseismic graphic shows potential far-side regions (top) with bright flux regions seen on the east limb in EUVI STEREO Ahead imagery (bottom).



Designation	Centroid Longitude (degree)	Centroid Latitude (degree)	Strength	ETA at East Limb (yyyy-mm-dd.d)	Days from East Limb
FS-2022-003	163.4	25.0	32	2022-07-29.1	0.1
FS-2022-008	134.4	18.6	666	2022-07-31.3	2.3
FS-2022-009	119.8	-18.6	1214	2022-08-01.7	3.7
FS-2022-010	77.0	-18.2	1534	2022-08-05.0	7.0
FS-2022-011	60.4	19.9	1301	2022-08-06.0	8.0



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Solar Radiation Storms - (High Energy Protons):

The high energy proton flux (greater than 10 MeV) is currently at Background levels and is currently expected to remain at this level through the period.

Radiation Storms Probability (Exceedance)	Level (cm^{-2} sr^{-1} s^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ S1**	No	1	1	1	1
Very Active	**≥ S3 ***	No	1	1	1	1
* S3 ≥ 10 MeV ≥ 1000 pfu and / or ≥ 50 MeV ≥ 10 pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)						

High Energy Electrons Event (≥ 2MeV):

The high energy electron flux (greater than 2MeV) as measured by GOES-16 is expected to continue fluctuating between background and moderate levels. This is likely to increase in response to any enhancement, perhaps briefly reaching High levels on day 3 and 4 during diurnal max.

The corresponding 24-hour fluence is expected to remain below the Active (1e8 integrated pfu) threshold through the period, with any enhancement unlikely to bring sufficiently persistent High flux to breach the Active level. This is supported by the REFM output.

GEO Electron Environment Probability (Exceedance)	Level (cm^{-2} sr^{-1} day^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ 2 MeV ≥ $1x10^8$**	No	1	1	5	10
Very Active	**≥ 2 MeV ≥ $1x10^9$**	No	1	1	1	1

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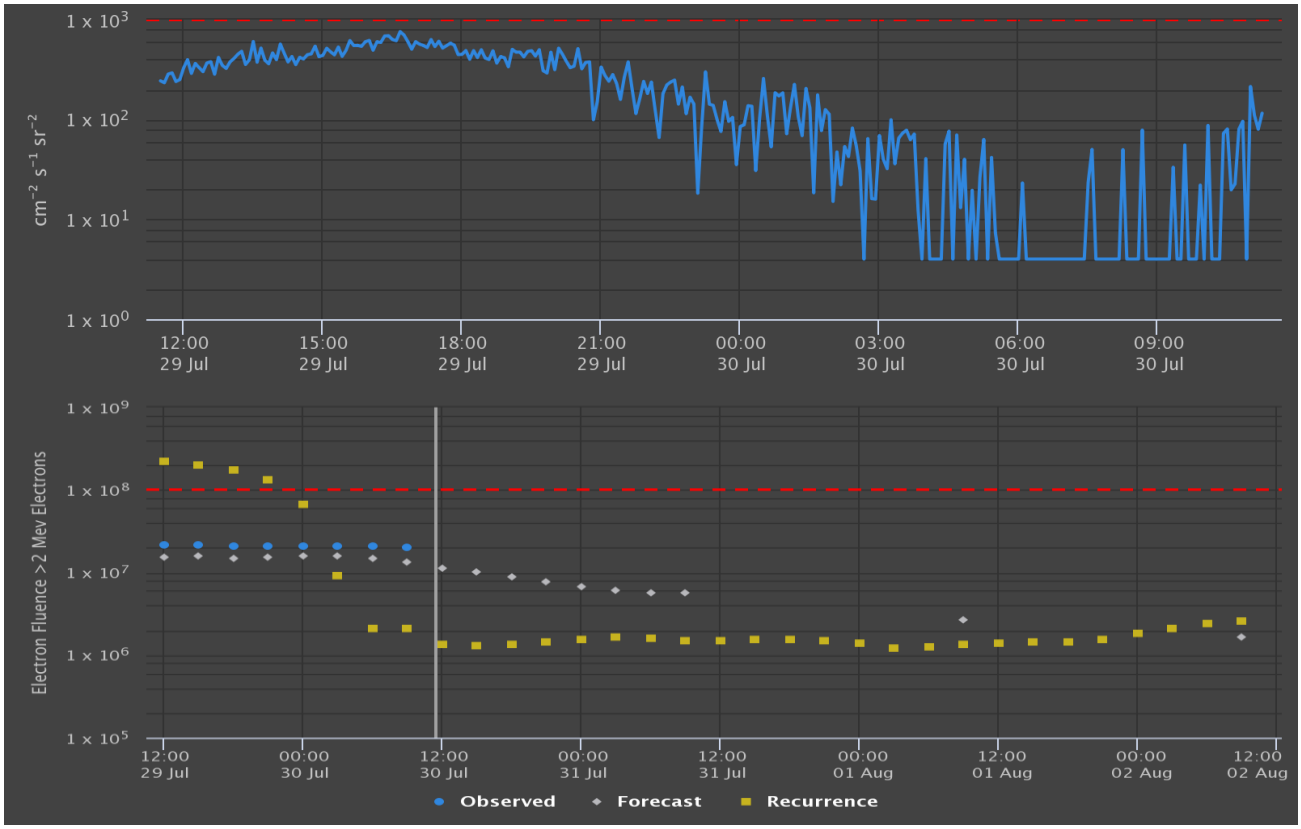
Figure 5: GOES-16 >2MeV Electron Flux (top) and Electron Fluence REFM and persistence (bottom).



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